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VEGETABLE PHYSIOLOGY.

Ecological Plant Geography.[1]—Plant geography can be considered from two standpoints. First, floristic plant geography, which treats of the flora of a region, a list of the species growing within certain geographical limits, the relative proportion of certain species, the relation of an insular flora to that of the mainland, or of a mountain flora to that of the adjacent valleys; that is, facts concerning distribution. Secondly, ecological plant geography, which treats of plant communities as resultants of all the forces working upon them.

The ordinary observer has no difficulty in noting that the plants over one area are different from those over another. He distinguishes the swamp, the meadow, the scrub, the pine-barren, the prairie, and other equally well-marked plant communities. What he notices, however, may not be that certain species of plants grow in one area and certain other species in another, it is rather the general appearance of the area, that is, its *physiognomy.* It is not a difficult matter to determine the species which are associated to form a certain plant community with its corresponding physiognomy. A more difficult question to answer is, however, " Why do these species unite into certain communities, and why have they the physiognomy which they possess?"

It is the task of the author in the 382 pages of the book before us to solve these questions. The author lays down a few general principles, some of which I cannot refrain from giving. " Every species must conform, both in inner and outer structure, to the natural conditions under which it lives, and if, when those change, it cannot adapt itself to them, it will be crowded out by other species, or become entirely eliminated. It is, therefore, one of the first and most important problems of ecological plant geography to understand the *epharmosis* [die Epharmonie, l'epharmonie] of the species, or what can be called its life-form [Lebensform]. This is shown especially in the configuration of the plant and in the duration of the [so-called] organs of assimilation (in the structure of the leaf and of the entire sprout, in the life period of the individual, etc.), and to a less degree in the reproductive organs. This problem leads one far into morphological, anatomical and physiological studies; it is very difficult, but very attractive. It cannot be entirely and satisfactorily solved, but much can be done in the future.

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[1] *Lehrbuch der Oekologischen Pflanzengeographie.* Dr. Eugenius Warming. Translated from the Danish by Dr. Emil Knoblauch, 1896, Berlin, Gebrüder. Borntræger.

" What increases the difficulty of the problem is, for example, the fact that besides the conforming power of many external factors, and besides the adaption of species to these factors, there are innate, hereditary dispositions, that from inner unknown causes produce structures which we cannot bring into any relation to the surrounding natural conditions, at all events not to those present, and which we cannot therefore understand. These inner dispositions, different according to the natural relationship, bring along with them this, that the development of the species under the influence of the same factors can lead to the same result in entirely different ways. While, for example, one species adapts itself to a dry habitat by means of a thick coating of hair, another species under the same conditions cannot bring forth a single hair, but choses, for example, to cover itself with a layer of wax, or to reduce its foliage and become a stem-succulent, or becomes ephemeral in its development." This paragraph explains fairly well the scope of the problem which the author endeavors to solve.

The term " Lebensform " is further explained. The cactuses, fleshy euphorbias and the succulent stapelias, though belonging to widely different families all possess the same life-form.

In a certain area or habitat, certain species have adapted themselves to the conditions there present, and so form a plant community (Pflanzenverein). Of course these plant communities cannot always be sharply divided, and the same species may occur in more than one community. But, nevertheless, each community possesses its peculiar physiognomy.

" Ecological plant geography must deal with the following:

" 1. The factors of the outside world that play a rôle in the economy of plants, and the action of these factors upon the external and internal structure of plants, upon the life-period and other ecological relations, as well as upon the topographical limits of the species.

"2. Grouping and characterizing of the classes of communities (Vereinklassen) present upon the surface of the earth.

" 3. The conflict between the communities."

The first section of the work deals with the ecological factors. The atmospheric factors are light, heat, moisture and air currents. The terrestrial factors are composition and physical condition of the soil, air and water in the soil, and other physical characters; the effect of dead or living mantle (snow or fallen leaves) upon the surface, of animals (earth-worms, moles, etc.), or plants (fungi, bacteria) beneath the surface of the soil, and finally; the effect of the direction and height of mountain chains, angle and direction of slope, and similar considerations.

But plants must adapt themselves not only to the physical conditions mentioned, but also to animals and to other plants. Man is far from an insignificant factor. The interdependence of plants and animals, such as flowers and pollinating insects, plants and ants, etc., though not discussed at length, plays a more or less important part in the battle.

The greatest struggle, however, is that which takes place between the plants themselves. A more or less stable equilibrium has been established in several ways. Parasitism, helotism (applied by the author to the relation of organisms in the lichen thallus), mutualism (root tubercles, etc.), epiphytes, with all their curious adaptations, saprophytes, lianas, are carefully considered. Over a given area where the various factors are comparatively constant, certain species are found which have adapted themselves to these conditions and to each other. These together make the plant community and present to the eye a certain physiognomy. Two plant communities living under similar conditions may present similar physiognomies, but may consist of widely different series of species. With the exception of subglacial and desert regions there is a conflict among individuals, those inherently less hardy and those accidentally unfavorably placed being first to succumb.

Hence, we have a kind of association known as commensalism. This term is sometimes used in the sense of mutualism (symbiosis); but, as used by the author, it means rather an established equilibrium between individuals struggling for the same food. It is to be noted that the strife between individuals of the same species is much greater than that between individuals of different species, since, for example, they may use different materials in the soil.

The first 120 pages of the work is taken up with preliminary discussions. as briefly outlined. The author gives a classification of the various plant communities. They are grouped in four classes, depending upon the relations of these to water. "The regulation of transpiration of plants appears to be the factor which influences most profoundly the forms of plants, and which imprints upon them most markedly their external characters. If the evaporation is greater than the water supply, the plant wilts, and this influences the most important life processes, even if it does not go so far that death results."

The classes are as follows:

"I. HYDROPHYTE-VEGETATION.—This is an extreme vegetation whose plants are either wholly, or, for the most part, surrounded by water, or grow in soil well filled with water (the per cent. of water amounts to probably more than 80).

"II. The XEROPHYTE-VEGETATION is the opposite extreme, whose plants grow upon stony soil, or, at least, during a greater portion of the year, in soil scarcely supplied with water, and in dry air. The water content can, indeed, if it is at a minimum amount, be less than 10 per cent.

"III. The HALOPHYTE-VEGETATION is closely related morphologically to the foregoing, but merits a separate consideration, an opinion that is confirmed, among others, by the investigations of Stahl. It is a very extreme vegetation, that is limited to salty soil and whose morphological peculiarities appear likewise to be caused by the regulation of evaporation.

"IV. The MESOPHYTE-VEGETATION includes the communities that are adopted to a soil and air of medium moisture, and to a soil also which is not particularly salty. The plants form a morphological and anatomical standpoint, are not especially extreme in their characters."

Space will not allow even an outline of the interesting chapters following, but for illustration we will glance at the xerophytes.

In the xerophytes adaptation has taken place along two lines, reduction of the transpiration during the critical period, and a development of especial means for gathering or storing water. Regulation of transpiration may be accomplished by reducing the evaporation in the following ways: 1. Periodical reduction of evaporating surface; deciduous trees dispense with their leaves in winter, bulbous plants relinquish the exposed parts in the dry season, annual plants pass this season in the seed stage; the leaves, especially of grasses or the thallus, may roll up in various ways. 2. The leaves change their position so as to regulate the amount of light, and consequently the amount of heat which they receive from the sun; many *Leguminosæ* place their leaflets in a vertical position during the heat of the day (para-heliotropism). Even our much-despised purslane shows this on a hot day; the common impression being that it is wilting—it knows better than that. 3. A permanent vertical position of the foliage organs. If the leaves are upright they tend to throw their surface into a meridional plane (compass plants). The leaves may be directed outwardly and twisted on their petioles (*Eucalyptus*), or hang on slender petioles (cotton-wood). The petioles may be laterally flattened and take the function of foliage (many *Acaciæ*). 4. The surface may be reduced in proportion to the volume, such as the needle-like leaves of the pine, the succulent leaves of the sedums, or where the stem acts as foliage and the leaves are reduced to scales, as in the cactus or asparagus. 5. The evaporation may be hindered by a coating of hairs, a common contrivance in dry regions, giving usually a gray color to the physiognomy. The hairs must be dead and filled with air. 6. Anatomical structure. The epidermis may be cutinized, or encrusted with various substances; the stomata may be sunken or otherwise protected. The contrivances for this purpose are legion. 7. The author calls attention to the frequent presence of etherial oils in xerophytes, and, though the use is not clear, suggests that the leaf becomes coated with a layer of the vapor of this volatile oil; and, since this layer is much less diathermous than air, the evaporation is lessened.

Under adaptations for absorbing water may be mentioned certain glandular hairs of desert plants and air-roots of epiphytic orchids. Some kinds of glandular hairs secrete hygroscopic salts, such as calcium chloride, which readily absorb water. "Volkens thinks that the plants take up water in this way. Marloth, however, regards this salt coat only as a covering to hinder transpiration, and even thinks that the plants thus free themselves from a part of the salts taken up."

Under storage of water we have various kinds of water tissue, succulent plants with sap which does not readily part with its water, and fleshy underground parts.

An outline of the xerophite classes may be of interest.

"A. Rock vegetation, that of the subglacial and temperate regions: that of dry tropics.

"B. Subglacial vegetation upon loose earth. Stony plains sparsely beset with plants, due often to lack of warmth rather than lack of moisture; moss heaths; lichen heaths.

"C. Dwarf-shrub heaths (mostly *Ericaceæ*).

"D. Sand vegetation, Strand flora, discussed more at length under Halophytes; vegetation of shifting dunes; vegetation of permanent dunes; sandy scrubs and timbered barrens.

"E. Tropical deserts.

"F. Xerophilous, herbaceous vegetation. Steppes and prairies; savannahs.

"G. Stony heaths (Felsenheiden) such as the Asiatic steppes covered with thorny shrubs.

"H. Xerophilous scrubs (Gebüsche). In arctic and temperate regions; in Alpine regions; tropical thorn-, palm-, fern-, bamboo-scrubs, etc.

"I. Xerophilous forests. Evergreen conifers; deciduous conifers; xerophilous, deciduous forests; leafless forests (*Casuarina*)."

The other three primary divisions are discussed in a similarly thorough manner. Swamp plants frequently possess xerophilous characters. Many suggestions are made to explain this, such as: in regions of high latitude or altitude, xerophilous characters lessen evaporation early in the season, when the roots are inactive, due to cold soil; or the activity of the roots is hindered by the difficulty of aeration, hence the need of lessened evaporation; or, again, since the stomata remaining open, cannot regulate evaporation, xerophilous characters are necessary.

The most probable explanation of the presence of xerophilous characters in halophytes is that the roots have difficulty in obtaining water from the strong solution of salts in which they are placed, hence the necessity of lessened evaporation.

The closing section treats of the struggle between the various plant communities.

The book should be read by every student of ecology; but more, the general reader would be amply repaid by its perusal. It is to be hoped that the book may be translated into English.*—A. S. HITCHCOCK.

ZOOLOGY.

The Gas of the Natatory Vessels of Physalia and of Fishes.[1]—As a result of a search[2] for argon in the natatory vessels of *Physalia* and of fishes there were found in the vessel of the former (*Physalia pelagica* Lk) from 85–91 per cent. of nitrogen, and from 9–15 per cent. of oxygen, but no other gas. In the swimming bladder of surface fish (*Polyprion cernium* Val.) there was found about 80 per cent. of nitrogen, 18 per cent. of oxygen, and 2 per cent. of carbonic acid gas, while in deep sea forms, such as *Murœna helena*, taken from a depth of 88 meters, and *Synaphobranchus pinnatus* Gr., taken from a depth of 1385 meters, 3–6 per cent. of carbonic acid gas and oxygen in the large amount of 73–85 per cent. were found.

The Genus Ascaris.—In his monographic work[3] devoted to this genus of worms, Stossich considers 218 species. Of this number 35

*An English translation of this book is now in preparation and will be published by Macmillan.—ED.

[1] Richard A. (96). Sur les gas de la vessie natatoire des poissons et des physalies. Bull. Mus. Hist. Nat., Paris, 41-3.

[2] Schloesing, Th., and Richard J. (96). Recherche de l'organ dans les gas de la vessie natatoire des poissons et des physalies. Compt. Rend. Ae. P., CXXII, 615-7.

Zool. Centralbl., IV, 19.

[3] Bull. Soc. Adriat. Sc. Nat., Trieste, XVII (1896), pp. 7-120. Zool. Centralbl., IV (1897), p. 20.